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L6 and (data ADJ flow)	9

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L9



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#### **Search History**

### DATE: Sunday, September 26, 2004 Printable Copy Create Case

Set Name side by side	Query	<u>Hit</u> <u>Count</u>	Set Name result set
DB = U	USPT; PLUR=NO; OP=OR		
<u>L9</u>	L6 and (data ADJ flow)	9	<u>L9</u>
<u>L8</u>	L6 AND DFD	0	<u>L8</u>
<u>L7</u>	L6 and (data ADJ flow) OR DFD	424	<u>L7</u>
<u>L6</u>	(ER ADJ diagram) OR (ER-Diagram) OR (entity-Relation ADJ diagram) OR (entity ADJ relation ADJ diagram)	35	<u>L6</u>
<u>L5</u>	L4 and (object ADJ diagram)	1	<u>L5</u>
<u>L4</u>	L3 and meta	16	<u>L4</u>
<u>L3</u>	L2 and relationship	60	<u>L3</u>
<u>L2</u>	L1 and association	85	<u>L2</u>
<u>L1</u>	717/103.ccls. or 717/108.ccls.	269	<u>L1</u>

#### **END OF SEARCH HISTORY**

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	<b>I</b>	5487135	all	all	N/A	USPT	
		5469539	all	all	N/A	USPT	
	<b>V</b>	6476814	all	all	N/A	USPT	

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Search Results - Record(s) 1 through 9 of 9 returned.

☐ 1. Document ID: US 6754181 B1

L9: Entry 1 of 9

File: USPT

STATE

ZIP CODE

Jun 22, 2004

COUNTRY

US-PAT-NO: 6754181

DOCUMENT-IDENTIFIER: US 6754181 B1

TITLE: System and method for a directory service supporting a hybrid communication

system architecture

DATE-ISSUED: June 22, 2004

INVENTOR-INFORMATION:

NAME CITY

Elliott; Isaac K. Colorado Springs

Krishnawswamy; Sridhar Cedar Rapid IA

US-CL-CURRENT: 370/252; 370/352, 370/356

#### ABSTRACT:

Telephone calls, data and other multimedia information is routed through a hybrid network which includes transfer of information across the internet utilizing telephony routing information and internet protocol address information. A media order entry captures complete user profile information for a user. This profile information is utilized by the system throughout the media experience for routing, billing, monitoring, reporting and other media control functions. Users can manage more aspects of a network than previously possible, and control network activities from a central site. A directory service that supports a hybrid communication system architecture is provided for routing traffic over the hybrid network and the internet.

12 Claims, 191 Drawing figures Exemplary Claim Number: 1 Number of Drawing Sheets: 133

Full   Title   Citation   Front   Re	eview   Classification   Date	Reference Sagikances Alterantents	Claims   KWIC   Draw, De
☐ 2. Document ID: U			en e
L9: Entry 2 of 9		File: USPT	May 4, 2004

US-PAT-NO: 6731625

Record List Display Page 2 of 7

DOCUMENT-IDENTIFIER: US 6731625 B1

TITLE: System, method and article of manufacture for a call back architecture in a hybrid network with support for internet telephony

DATE-ISSUED: May 4, 2004

INVENTOR - INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Eastep; Guido M. McKenney TX Litzenberger; Paul Wilie TX Orebaugh; Shannon R. Herndon VA

US-CL-CURRENT: <u>370/352</u>; <u>370/389</u>, <u>370/392</u>, <u>379/114.01</u>, <u>379/90.01</u>, <u>379/93.07</u>

#### ABSTRACT:

A callback system is created utilizing a hybrid telecommunication system including a switched communication network and a packet transmission network. A call parameter database is stored in a memory. A call is received on the system. The call parameter database is accessed to determine at least one call parameter. The call is routed over the switched communication network and the packet transmission network based on the at least one call parameter. A plurality of service engines is provided, each configured to execute desired service logic utilizing expert system.

39 Claims, 188 Drawing figures Exemplary Claim Number: 1 Number of Drawing Sheets: 187

Full	Title	Citation	Front	Review	Classification	Date	Reference	Margarita	o#kannoom;	Claims	KWIC	Drawt De

☑ 3. Document ID: US 6476814 B1

L9: Entry 3 of 9

File: USPT

Nov 5, 2002

US-PAT-NO: 6476814

DOCUMENT-IDENTIFIER: US 6476814 B1

TITLE: Display structure for representation of complex systems

DATE-ISSUED: November 5, 2002

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Garvey; Robert B. Lake Lotawana MO

US-CL-CURRENT: 345/440

#### ABSTRACT ·

A multi-dimensional outline, a wordgraph, represents a subset of a directed graph with a given starting node where all edges related to a node in one direction,

either incident out of that node or incident into that node appear indented below that node as in outlining represented by their terminal node or initial node respectively and all edges related in the other direction appear indented above that node represented by their initial node or terminal node, respectively, with the initial nodes and terminal nodes distinguished.

10 Claims, 2 Drawing figures Exemplary Claim Number: 1 Number of Drawing Sheets: 2

Full	Title	Citation	Front	Review	Classification	Date	Reference	e Mailtean from	Claims	KWIC	Draw, De
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☐ 4. Document ID: US 6335927 B1

L9: Entry 4 of 9

File: USPT

Jan 1, 2002

US-PAT-NO: 6335927

DOCUMENT-IDENTIFIER: US 6335927 B1

TITLE: System and method for providing requested quality of service in a hybrid network

DATE-ISSUED: January 1, 2002

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Elliott; Isaac K. Colorado Springs CO Reynolds; Tim E. Iowa City IA

Krishnaswamy; Sridhar Cedar Rapid IA

US-CL-CURRENT: 370/352

#### **ABSTRACT:**

Telephone calls, data and other multimedia information is routed through a hybrid network which includes transfer of information across the internet. A media order entry captures complete user profile information for a user. This profile information is utilized by the system throughout the media experience for routing, billing, monitoring, reporting and other media control functions. Users can manage more aspects of a network than previously possible, and control network activities from a central site. The hybrid network also contains logic for responding to requests for quality of service and reserving the resources to provide the requested services.

16 Claims, 191 Drawing figures Exemplary Claim Number: 1 Number of Drawing Sheets: 133

Full Title	Citation	Front	Review	Classification	Date	Reference	Company 12s	effethirms	Claims	KWC	Draw, De

5. Document ID: US 5999525 A

L9: Entry 5 of 9

File: USPT

ΙA

Dec 7, 1999

US-PAT-NO: 5999525

DOCUMENT-IDENTIFIER: US 5999525 A

TITLE: Method for video telephony over a hybrid network

DATE-ISSUED: December 7, 1999

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Krishnaswamy; Sridhar Cedar Rapids IA Elliott; Isaac K. Colorado Springs CO

Reynolds; Tim E. Iowa City IA

Solbrig; Erin M. Cedar Rapids IA

US-CL-CURRENT: 370/352; 370/389, 370/392, 379/114.15, 379/90.01, 379/93.07

Iowa City

#### ABSTRACT:

Forgy; Glen A.

Telephone calls, data and other multimedia information including video, audio and data is routed through a switched network which includes transfer of information across the internet. Users can transmit video, audio and data communications of designated quality over the internet to other registered video telephony users. Users can manage more aspects of a network than previously possible, and control network activities from a central site.

30 Claims, 190 Drawing figures Exemplary Claim Number: 11 Number of Drawing Sheets: 134

Full	Title	Citation	Front	Review	Classification	Date	Reference	Facility Chronical	Alellandie.	Claims	KWIC	Draw, De

☐ 6. Document ID: US 5867495 A

L9: Entry 6 of 9

File: USPT

Feb 2, 1999

US-PAT-NO: 5867495

DOCUMENT-IDENTIFIER: US 5867495 A

TITLE: System, method and article of manufacture for communications utilizing

calling, plans in a hybrid network

DATE-ISSUED: February 2, 1999

INVENTOR-INFORMATION:

NAME CITY STATE ZIP CODE COUNTRY

Elliott; Isaac K. Colorado Springs CO

Krishnaswamy; Sridhar

Cedar Rapids

ΙA

US-CL-CURRENT: 370/352; 370/389, 370/392, 379/11, 379/115.01, 379/90.01, 379/93.07

#### ABSTRACT:

Telephone calls, data and other multimedia information is routed through a hybrid network which includes transfer of information across the internet utilizing telephony routing information and internet protocol address information. A media order entry captures complete user profile information for a user. This profile information is utilized by the system throughout the media experience for routing, billing, monitoring, reporting and other media control functions. Users can manage more aspects of a network than previously possible, and control network activities from a central site. Calling card access is provided for users and supports typical calls as well as media transfers over the hybrid network including over the internet.

27 Claims, 190 Drawing figures Exemplary Claim Number: 19 Number of Drawing Sheets: 132

I	Full	Title	Citation	Front	Review	Classification	Date	Reference	Striplesty "	ik him ansa	Claims	KWIC	Drawi De
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☐ 7. Document ID: US 5867494 A

L9: Entry 7 of 9

File: USPT

Feb 2, 1999

US-PAT-NO: 5867494

DOCUMENT-IDENTIFIER: US 5867494 A

TITLE: System, method and article of manufacture with integrated video conferencing billing in a communication system architecture

DATE-ISSUED: February 2, 1999

#### INVENTOR - INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Krishnaswamy; Sridhar	Cedar Rapids	IA		
Elliott; Isaac K.	Colorado Springs	CO		
Reynolds; Tim E.	Iowa City	IA		
Forgy; Glen A.	Iowa City	IA		
Solbrig; Erin M.	Cedar Rapids	IA		

US-CL-CURRENT: 370/352; 370/389, 370/392, 379/114.15, 379/90.01, 379/93.07

#### ABSTRACT:

Telephone calls, data and other multimedia information including video, audio and data is routed through a switched network which includes transfer of information across the internet. Users can participate in video conference calls in which each participant can simultaneously view the video from each other participant and hear the mixed audio from all participants. Users can also share data and documents with

other video conference participants. Users can manage more aspects of a network than previously possible, and control network activities from a central site. Billing of the conference call is accomplished utilizing a billing detail record to capture events associated with a call as they occur and debit the appropriate bill.

20 Claims, 192 Drawing figures Exemplary Claim Number: 7 Number of Drawing Sheets: 134

Full Title Citation Front Review Classification Date Reference Seutlences Affectionents Claims KWC Draw De

☑ 8. Document ID: US 5487135 A

L9: Entry 8 of 9

File: USPT

Jan 23, 1996

US-PAT-NO: 5487135

DOCUMENT-IDENTIFIER: US 5487135 A

TITLE: Rule acquisition in knowledge based systems

DATE-ISSUED: January 23, 1996

INVENTOR-INFORMATION:

NAME

CITY

STATE ZIP CODE

COUNTRY

Freeman; Paul R. W.

Southville Bristol

GB2

US-CL-CURRENT: 706/59

#### ABSTRACT:

A rule-based system, concerned with a domain of knowledge or operations (the domain theory) and having associated therewith a rule-based entity relationship (ER) system (the ER theory) which represents the domain theory diagrammatically, is supported by a computer system. The system, which constructs a new rule for the domain theory, controls the entry into conditions storage memory or note pad (16) of conditions which together represent the desired rule, and rule assembly logic (17) that generates the desired rule from those entries. A display device (14) displays an ER diagram (FIG. 2) obtained from the ER theory and stored in memory (11, 12). An operator selects, via a mouse and control logic (13, 15), elements of the ER diagram. These elements are entered into the conditions storage means or note pad (16). Attributes are entered via a combination of selection from the ER diagram and semantic constraints on their values. When all elements and attributes have been so entered, they are compiled into the new rule by rule assembly logic (17) and assimilated into the domain theory by assimilator logic (18).

15 Claims, 9 Drawing figures Exemplary Claim Number: 8 Number of Drawing Sheets: 8

Full Title Citation Front Review Classification Date Reference Sequences Patrocampaign Claims KWIC Draws De

#### ☑ 9. Document ID: US 5469539 A

L9: Entry 9 of 9

File: USPT

Nov 21, 1995

US-PAT-NO: 5469539

DOCUMENT-IDENTIFIER: US 5469539 A

TITLE: Method for abstracting/detailing structuring elements of system

specification information

DATE-ISSUED: November 21, 1995

INVENTOR - INFORMATION:

NAME

CITY

STATE

ZIP CODE

COUNTRY

Usuda; Yutaka

Yokohama

JP

US-CL-CURRENT: 345/841; 345/440, 345/853

#### ABSTRACT:

The specification abstracting-detailing system stores system specification information\_in\_a\_hierarchical structure. A hierarchy operation\_selects\_an\_object\_to be detailed or abstracted from the specification information, for updating hierarchical information of a hierarchy between specification information of the hierarchy in such a state that a logical relation of the specification information contained in the hierarchy of the object selected, and for creating or deleting a new hierarchy. This allows the abstracting and detailing to be performed in the course of a natural thinking process by a designer.

1 Claims, 12 Drawing figures Exemplary Claim Number: 1 Number of Drawing Sheets: 11

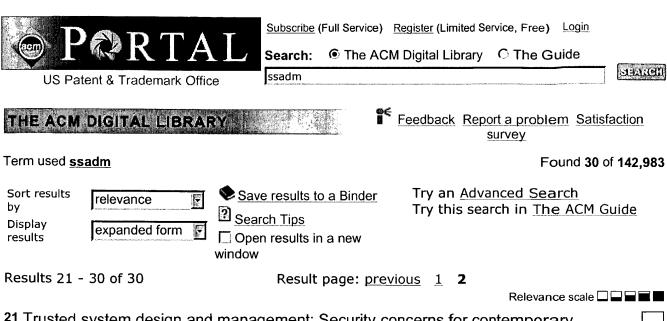
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21 Trusted system design and management: Security concerns for contemporary development practices: a case study

T. Tryfonas, E. Kiountouzis

June 2001 Proceedings of the 16th international conference on Information security: Trusted information: the new decade challenge

Additional Information: full citation, abstract, references, index terms

This paper presents a case of application of an interpretive framework, which intends to formally integrate information systems security concerns within the information system's lifecycle. Aspects that are not normally taken under consideration, such as the involved stakeholders, the development approach and their implication to security issues, are introduced in such a way to benefit and empower the IS security design process. In the case presented here, the framework is used to extract a power ...

Keywords: action research, contemporary IS development approaches, information systems security design, information systems security practices

22 Specification and modeling: an academic perspective Manfred Broy

July 2001 Proceedings of the 23rd international conference on Software engineering

Publisher Site

Full text available: pdf(63.39 KB) Additional Information: full citation, abstract, index terms

The specification and modeling of software systems, of their aspects, and their development processes is at the heart of software engineering. Over the years, we have achieved a much deeper and more comprehensive understanding of software and its models as a basis for its specification. However, there is still a way to go to make sure that all we know right now is transferred into practice, and that all we do not understand so far is investigated in depth. The goal is a tractable scientifi ...

Keywords: modeling, quality assurance, requirements engineering, specification, tool support

23 Adoption of IS development methods across cultural boundaries Gezinus J. Hiddina December 1998 Proceedings of the international conference on Information systems

	Full text available: pdf(21.81 KB) Additional Information: full citation, references, index terms	
	<b>Keywords</b> : cultural differences, empirical research, globalization, managerial control, organizational procedures, social science	
24	An empirically-grounded framework for the information systems development process Brian Fitzgerald December 1998 Proceedings of the international conference on Information systems Full text available: pdf(54.94 KB) Additional Information: full citation, references, index terms	
	<b>Keywords</b> : IS development approaches, IS development methodologies, information systems, information systems development, pluralist research	
25	Dynamics of process models in PML R. A. Snowdon, Clive Roberts	
	October 1990 Proceedings of the 5th international software process workshop on	
	Experience with software process models  Full text available: pdf(146.90 KB) Additional Information: full citation, abstract, references, index terms	
	The IPSE 2.5 project is concerned with the problem of how computer systems can be used in the development of information systems. The project is being carried out under the UK Alvey Programme Software Engineering Strategy by a consortium comprising STC Technology Limited, International Computers Limited, University of Manchester, Dowty Defense and Air Systems Limited, SERC Rutherford Appleton Laboratories, Plessey Research Roke Manor Ltd. and British Gas plc. Praxis Systems has w	
26	Guilty or not guilty? human factors structured methods on trial John Long, Simon Hakiel, Leela Damodoran, Bill Hefley, Kee Yong Lim April 1994 Conference companion on Human factors in computing systems	
	Full text available: pdf(261.87 KB) Additional Information: full citation	
27	Requirements rationales: integrating approaches to requirement analysis  Alistair Sutcliffe  August 1995 Proceedings of the conference on Designing interactive systems:  processes, practices, methods, & techniques  Full text available: pdf(999.72 KB) Additional Information: full citation, references, citings, index terms	
28	Methods, models and architectures for graphical user interface design: IFIP working groups 13.2/2.7 joint workshop, Loughborough, UK, September 1994 Alistair Sutcliffe, Len Bass, Gilbert Cockton, Andrew Monk, Ian Newman October 1995 <b>ACM SIGCHI Bulletin</b> , Volume 27 Issue 4 Full text available: pdf(436.17 KB) Additional Information: full citation, index terms	

29 <u>Development of an OO infrastructure for mainframe database applications</u>
Darryl James Rothering

October 1994 ACM SIGPLAN Notices, Proceedings of the ninth annual conference on Object-oriented programming systems, language, and applications, Volume 29 Issue 10

Full text available: pdf(839.77 KB) Additional Information: full citation, abstract, references, index terms

Large mainframe installations need and want to exploit the advantages of Object Technology (OT), but without totally abandoning their legacy environments. Implementing Object Orientation in such a COBOL/CICS/DB2 environment is a challenge: there is neither language support, nor development tools, nor execution infrastructure, nor testing utilities. Yet Object Orientation can be fully implemented, and a project can still meet rigorous performance requirements and tough delivery time scales. ...

30 A software assessment and certification advisor

Hans-Ludwig Hausen

April 1992 Proceedings of the 1992 ACM annual conference on Communications

Full text available: pdf(903.09 KB) Additional Information: full citation, abstract, references, index terms

Software assessment and certification is specified by using rules to define a product model, a process model, a characteristics model, software methods and tools. The product is divided into actual service (i.e. programs), specified service (i.e. specifications) and expected service (ie requirements). Associated to these are the quality characteristics, defined by metrics. Assessment as certification is introduced as a particular process phase. The advisor specified produces advice on produ ...

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Relevance scale

Scheduling threads for low space requirement and good locality

Girija J. Narlikar

June 1999 Proceedings of the eleventh annual ACM symposium on Parallel algorithms and architectures

Full text available: pdf(1.69 MB)

Additional Information: full citation, references, citings, index terms

DSS structure and algorithmic transparency in APL

W. E. Cundiff

July 1991 ACM SIGAPL APL Quote Quad, Proceedings of the international conference on APL '91, Volume 21 Issue 4

Full text available: pdf(897.81 KB) Additional Information: full citation, abstract, references, index terms

Earlier discussion focused on APL as an executable notation for understanding the innerworkings of dialogue generation and data/model base management in Decision Support Systems (DSS). The present work applies the notion of algorithmic transparency to the broader properties of system structure that connect the technology components of DSS. Using a concise set of idioms, embodying only the control construct of sequence, APL's direct definition form is employed in revealing patterns in the specif ...

3 Support hull: relating the cayley-dixon resultant constructions to the support of a polynomial system

Arthur D. Chtcherba, Deepak Kapur

July 2004 Proceedings of the 2004 international symposium on Symbolic and algebraic computation

Full text available: pdf(222.85 KB) Additional Information: full citation, abstract, references, index terms

A geometric concept of the support hull of the support of a polynomial was used earlier by the authors for developing a tight upper bound on the size of the Cayley-Dixon resultant matrix for an unmixed polynomial system. The relationship between the support hull and the Cayley-Dixon resultant construction is analyzed in this paper. The support hull is shown to play an important role in the construction and analysis of resultant matrices based on the Cayley-Dixon formulation, similar to th ...

**Keywords**: dialytic method, dixon resultant formulation, resultant, support, support hull, support-hull interior point, sylvester-type matrices, variable ordering

Spreadsheet analysis and design Boaz Ronen, Michael A Palley, Henry C. Lucas February 1989 Communications of the ACM, Volume 32 Issue 1

Full text available: pdf(860.11 KB)

Additional Information: full citation, abstract, references, citings, index terms, review

Although spreadsheet programs and microcomputers have revolutionized information processing in organizations, a significant number of serious errors have been reported through the misuse of this technology. This article discusses several different contexts for the development of spreadsheet models and presents structured design techniques for these models.

5 Software considerations for the "black box" solver FIDISOL for partial differential equations

Willi Schönauer, Eric Schnepf

December 1987 ACM Transactions on Mathematical Software (TOMS), Volume 13 Issue 4

Full text available: pdf(1.32 MB)

Additional Information: <u>full citation</u>, <u>abstract</u>, <u>references</u>, <u>citings</u>, <u>index</u> terms, <u>review</u>

FIDISOL is a program package for the solution of nonlinear systems of two-dimensional and three-dimensional elliptic and parabolic partial differential equations (PDEs) with nonlinear boundary conditions (BCs) on the boundaries of a rectangular domain. A finite difference method (FDM) with an arbitrary grid and arbitrary consistency order is used, these are either prescribed by the user or are self-adapted for a given relative tolerance. FIDISOL has been designed to be fully vectorizable on ...

6 Conditions for exact resultants using the Dixon formulation

Arthur D. Chtcherba, Deepak Kapur

July 2000 Proceedings of the 2000 international symposium on Symbolic and algebraic computation

Full text available: pdf(236.60 KB)

Additional Information: <u>full citation</u>, <u>abstract</u>, <u>references</u>, <u>citings</u>, <u>index</u> terms

A structural criteria on polynomial systems is developed for which the generalized Dixon formulation of multivariate resultants defined by Kapur, Saxena and Yang (1994) computes the resultant exactly. The concept of a Dixon-exact support (the set of exponent vectors of terms appearing in a polynomial system) is introduced so that the Dixon formulation produces the exact resultant for generic unmixed polynomial systems whose support is Dixon-exact. A geometric operation, called direct-sum, o ...

7 Software engineering of virtual worlds

G. Jounghyun Kim, Kyo Chul Kang, Hyejung Kim, Jiyoung Lee

November 1998 Proceedings of the ACM symposium on Virtual reality software and technology

Full text available: pdf(1.12 MB)

Additional Information: full citation, references, citings, index terms

8 Column: APLUM-APL at the University of Massachusetts Rick Mayforth

April 1975 ACM SIGAPL APL Quote Quad, Volume 6 Issue 1

Full text available: pdf(547.45 KB) Additional Information: full citation, references

A reengineering framework for evaluating a financial imaging system

Henry C. Lucas, Donald J. Berndt, Greg Truman May 1996 Communications of the ACM, Volume 39 Issue 5

Full text available: 📆 pdf(261.73 KB) Additional Information: full citation, references, citings, index terms

10 Image retrieval: Retrieving 3D shapes based on their appearance

Ryutarou Ohbuchi, Masatoshi Nakazawa, Tsuyoshi Takei

November 2003 Proceedings of the 5th ACM SIGMM international workshop on Multimedia information retrieval

Full text available: pdf(559.66 KB) Additional Information: full citation, abstract, references, index terms

In this paper, we propose an algorithm for shape-similarity comparison and retrieval of 3D shapes defined as polygon soup. One of the issues in comparing 3D shapes is the diversity of shape representations used to represent these "3D" shapes. While a solid model is welldefined and is easier to handle, others such as polygon soup poses many problems. In fact, a polygon soup 3D model most often does not define a 3D shape, but merely an illusion of "3D shape-ness" by its collection of independent ...

Keywords: depth map, geometric modeling, polygon soup, polygonal mesh, shape similarity search, three-dimensional models

11 Timing extensions to structured analysis for real time systems

L. Peters

April 1989 ACM SIGSOFT Software Engineering Notes, Proceedings of the 5th international workshop on Software specification and design, Volume 14 Issue 3

Full text available: pdf(671.89 KB) Additional Information: full citation, references, citings, index terms

12 Practical safety in flexible access control models

Trent Jaeger, Jonathon E. Tidswell

May 2001 ACM Transactions on Information and System Security (TISSEC), Volume 4 Issue 2

Full text available: pdf(346.47 KB)

Additional Information: full citation, abstract, references, citings, index terms

Assurance that an access control configuration will not result in the leakage of a right to an unauthorized principal, called safety, is fundamental to ensuring that the most basic of access control policies can be enforced. It has been proven that the safety of an access control configuration cannot be decided for a general access control model, such as Lampson's access matrix, so safety is achieved either through the use of limited access control models or the verification of safety via ...

Keywords: Access control models, authorization mechanisms, role-based access control

13 Evaluation of vendor products: CASE tools as methodology companions Iris Vessey, Sirkka L. Jarvenpaa, Noam Tractinsky

April 1992 Communications of the ACM, Volume 35 Issue 4

Full text available: pdf(1.96 MB) Additional Information: full citation, references, citings, index terms

Keywords: CASE tools, methodology companion, structured analysis and design

14 <u>Visualization '91 workshop report: scientific visualization environments</u> David M. Butler, Charles Hansen August 1992 <b>ACM SIGGRAPH Computer Graphics</b> , Volume 26 Issue 3	
Full text available: pdf(452.66 KB) Additional Information: full citation, abstract, citings, index terms	
The Workshop on Scientific Visualization Environments at Visualization '91 was organized with several purposes in mind. First and foremost was to bring together widely dispersed researchers so they could share information in a relatively informal and interactive environment. The organizers believed this would establish working relationships between the participants, which was a second purpose. It was hoped that a workshop could generate a focus and identify important research directions in the f	
15 Algorithm 315: The damped Taylor's series method for minimizing a sum of squares	
and for solving systems of nonlinear equations  H. Späth	
November 1967 Communications of the ACM, Volume 10 Issue 11	
Full text available: pdf(482.27 KB) Additional Information: full citation, index terms	
16 Algorithm 314: Finding a solution of N functional equations in N unknowns	
D. B. Dulley, M. L. V. Pitteway November 1967 <b>Communications of the ACM</b> , Volume 10 Issue 11	
Full text available: pdf(482.27 KB) Additional Information: full citation, references, index terms	
17 Software engineering: applications, practices tools (SE): A new approach to the BDI agent-based modeling Chang-Hyun Jo, Guobin Chen, James Choi March 2004 Proceedings of the 2004 ACM symposium on Applied computing	
Full text available: pdf(250.23 KB) Additional Information: full citation, abstract, references	
Intelligent agents have been regarded as a new notion to build complex software systems. In this paper, we propose an agent-based software development process based on Belief-Desire-Intention (BDI) agent model as a new software development process. The Belief-Desire-Intention (BDI) model has been used as a fundamental ingredient to the new agent-based modeling method. In our agent system proposed here, each agent is made flesh by assigning its own belief, desire and intention. Here we have shown	
Keywords: CASE tool, agent-based modeling, agent-oriented software engineering	
18 An indeterminate constructor for applicative programming Daniel P. Friedman, David S. Wise January 1980 Proceedings of the 7th ACM SIGPLAN-SIGACT symposium on Principles of programming languages Full text available: pdf(518.02 KB) Additional Information: full citation, abstract, references, citings	
This paper proposes the encapsulization and control of contending parallel processes within	
data structures. The advantage of embedding the contention within data is that the contention, itself, thereby becomes an object which can be handled by the program at a level above the actions of the processes themselves. This means that an indeterminate behavior, never precisely specified by the programmer or by the input, may be shared in the same way that an argument to a function is shared by every upon the contention of the processes within data is that the	

19 <u>Lightfield acquisition & display: A stereo display prototype with multiple focal distances</u>
Kurt Akeley, Simon J. Watt, Ahna Reza Girshick, Martin S. Banks
August 2004 **ACM Transactions on Graphics (TOG)**, Volume 23 Issue 3

Full text available: pdf(304.43 KB) Additional Information: full citation, abstract, references, index terms

Typical stereo displays provide incorrect focus cues because the light comes from a single surface. We describe a prototype stereo display comprising two independent fixed-viewpoint volumetric displays. Like autostereoscopic volumetric displays, fixed-viewpoint volumetric displays generate near-correct focus cues without tracking eye position, because light comes from sources at the correct focal distances. (In our prototype, from three image planes at different physical distances.) Unlike autos ...

**Keywords**: graphics hardware, hardware systems, optics, user-interface hardware, virtual reality

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David S. Homiak

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#### A BLIND SAG-SO-DFD-FS EQUALIZER

G.Picchi Universita' di Pisa. Istituto di Elettronica e Telecomunicazioni. Pisa, Italy

Abstract - Self-orthogonalization (SO) in the discrete frequency domain (DFD) and blind equalization using a stopand-go (SAG) algorithm are studied for application to fractionally spaced (FS) equalizers. Problems arise when attempting a direct transposition to this case of the results known for synchronous equalizers, e.g. blind convergence is difficult to achieve. This is mainly due to the different properties of the input sequence matrix. An algorithm is correlation proposed that achieves blind convergence by combining the two suitably tailored techniques for fractionally spaced equalizers.

#### 1 - Introduction

Self-orthogonalization (SO) is a fast-converging method used in adaptive equalization to speed-up convergence towards the minimum mean square error (MSE) between the equalizer output and a desired sequence. Since the speed of convergence of the usual gradient algorithm, strongly depends on the eigenvalue spreading of the input sequence correlation matrix, spreading reduction makes convergence faster. Self-orthogonalization reduces the spreading ideally achieving convergence in only one step [1],[2].

Aside from self-orthogonalization, blind equalization has been developed to make convergence possible without resorting to any initial training sequence [3]. Recently a blind Stopand-Go (SAG) algorithm has been proposed based on stopping adaptation of a normal gradient algorithm whenever the updating term fails a simple reliability test [4].

In this paper the application of the SAG algorithm to fractionally spaced (FS) equalizers is considered. Unfortunately the SAG algorithm is not very effective when directly applied to FS equalizers which is mainly due to

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the eigenvalue spreading of the input correlation matrix. Self-orthogonalization is shown to be useful to combat the effect. In the following a new blind self-orthogonalizing algorithm in the Discrete Frequency Domain (DFD) is developed for application to fractionally spaced equalizers and its performances are evaluated by computer simulation.

2 - Basic fractionally spaced equalizer
A complex FIR adaptive equalizer
with T/2-spaced taps will be considered
throughout the paper, being T the
Nyquist interval. Let

be the input sequence with T/2-spaced samples. Subscript S indicates synchronous samples, i.e. T-spaced samples that would be present at the input of a synchronous equalizer. Subscript F indicates the corresponding fractional samples following T/2 apart.

An equalizer with 2M taps is shown in Fig.1. Every T seconds an output sample  $y_k$  is produced and a desired sample  $d_k$  is subracted from  $y_k$  to yield the error sample  $e_k$ .

Let

$$z_{k}=[z_{F,k} z_{S,k} z_{F,k-1} z_{S,k-1}... (2)$$
 $...z_{F,k-H+1} z_{S,k-H+1}]^{T}$ 

$$Ck = \{CF, 0 \ CS, 0 \ CF, 1 \ CS, 1 \dots \}_{k}^{T}$$
 (3)

be the stored samples vector and the tap vector respectively.

For a given c the MSE is expressed by the quadratic form (overbar=complex conjugate)

$$\mathcal{E} = \mathbb{E}\{\mathbf{e}_{\mathbf{k}} \ \bar{\mathbf{e}}_{\mathbf{k}}\} = \mathbf{c}^{\mathsf{T}} \mathbf{A} \ \bar{\mathbf{c}} - \mathbf{c}^{\mathsf{T}} \ \bar{\mathbf{b}} - \mathbf{b}^{\mathsf{T}} \ \bar{\mathbf{c}} + \mathbf{K} \quad (4)$$

where

This work was supported in part by GTE Telecomunicazioni, Italy

#### 30.4.1.

 $A=E\{z_k \ \bar{z}_k^T\}; \ b=E\{\bar{z}_k \ d_k\}; \ K=E\{d_k \ \bar{d}_k\} \ (5)$ 

Starting from an initial tap vector co the MSE can be recursively minimized by using either the deterministic or the stochastic gradient as follows

$$\mathbf{ck} \cdot \mathbf{1} = \mathbf{ck} - \alpha(\nabla \varepsilon) \mathbf{k} = \mathbf{ck} - \alpha(\overline{\mathbf{A}} \mathbf{ck} - \mathbf{b}) \quad (6.1)$$

$$\mathbf{ck} \cdot \mathbf{1} = \mathbf{ck} - \alpha(\widehat{\nabla \varepsilon}) \mathbf{k} = \mathbf{ck} - \alpha(\overline{\mathbf{z}} \mathbf{k} \mathbf{ek}) \quad (6.2)$$

where  $\alpha$  is the correction step size. For  $\alpha$  suitably small (6.1) and (6.2) converge respectively to

$$c_{opt} = \bar{A}^{-1} b$$
 and  $E\{c_{opt} = c_{opt}$  (7)

In the latter case convergence is to be intended in the mean.

#### 3 - Self-orthogonalization

Convergence of algorithms (6) strongly depends on the eigenvalue spreading of matrix A and it can be extremely slow as shown in Fig.2 where a complex FS equalizer for a 256-QAM digital radio link on multipath dispersive channel is considered.

Spreading reduction via time-domain self-orthogonalization is accomplished pre-multiplying the gradient by  $\bar{A}^{-1}$ . One-step convergence is achieved in the non-stochastic case i.e.

$$c_{k+1} = c_k - \bar{A}^{-1} (\bar{A} c_k - b) = \bar{A}^{-1} b = c_{opt}$$
 (8)

In the stochastic case the correlation matrix is to be estimated and the estimate inverted. A time domain self-orthogonalizing algorithm derived from (6.2) is then

$$\mathbf{C}_{k+1} = \mathbf{C}_k - \alpha(\widehat{\mathbf{A}}^{-1})_k \ \mathbf{z}_k \ \mathbf{e}_k \tag{9}$$

where the estimate  $(\overline{A}^{\,\text{--}\,1})_{\,k}$  can be computed as follows

$$(\widehat{\bar{A}^{-1}})_{k} = (\widehat{\bar{A}_{k}})^{-1} = (1/k+1)(\delta I + \sum_{i=0}^{k} z_{i} \ \bar{z}_{i}^{T})^{-1}$$

being &I an inizializaton matrix.

Self-orthogonalization in discrete frequency domain allows some complexity reduction by exploiting properties of the Discrete Fourier Transform (DFT) and of circulant matrices to turn A into a diagonal matrix for easier inversion. This technique, proposed in [2] for synchronous equalizers, cannot be directly used in the fractional case due to a different form of matrix A. However we show in the following that the same technique be profitably applied to submatrices of a re-ordered version of A.

4 - A DFD self-orthogonalizing algorithm for FS equalizers

Observe that the input sequence {zk} is composed of the sequences {zs,k} and {zr,k} of the T-spaced synchronous and fractional samples interlaced and that their auto- and cross-correlation samples appear in matrix A arranged as follows

$$A = E\{z_k \ \bar{z}_k^{\dagger}\} = \tag{11}$$

where for any combination of  $X,Y \in \{F,S\}$ 

$$Rxy(m) = E\{zx, k \overline{z}y, k+m\} = \overline{R}_{yx}(-m)$$

is the cross-correlation of processes  $\{zx,k\}$  and  $\{zy,k\}$  supposed different from zero only for  $|m| \le (G-1)$ .

Let us now re-define zk and ck taking apart their synchronous and fractional components

$$\mathbf{z}_{k} = \begin{bmatrix} \mathbf{z}_{F}^{\mathsf{T}}, k & \mathbf{z}_{S}^{\mathsf{T}}, k \end{bmatrix}^{\mathsf{T}}; \quad \mathbf{c}_{k} = \begin{bmatrix} \mathbf{c}_{F}^{\mathsf{T}}, k & \mathbf{c}_{S}^{\mathsf{T}}, k \end{bmatrix}^{\mathsf{T}}$$
 (12)

where

$$ZF, k = [ZF, k ZF, k-1 \dots ZF, k-H+1]^T$$
 $CF, k = [CF, 0 CF, 1 \dots CF, H-1]^T$ 

are the sorted fractional vectors. The synchronous vectors  $\mathbf{z}_{s,k}$ ,  $\mathbf{c}_{s,k}$  are similarly defined.

Using definitions (12) the MSE is still expressed by (4) with A and  ${\bf b}$  defined as follows

$$A = \begin{vmatrix} A_{FF} & A_{FS} \\ --- & --- \\ A_{SF} & A_{SS} \end{vmatrix}; \quad \mathbf{b} = [ \mathbf{b}_{F}^{\mathsf{T}} & \mathbf{b}_{S}^{\mathsf{T}} ]^{\mathsf{T}} \quad (13)$$

where for any combination of  $X,Y \in \{F,S\}$ 

$$Axy=E\{zx, k \ \overline{z}_{1}^{\tau}, k\}=\overline{A}_{2}^{\tau}, b\}=\overline{A}_{2}^{\tau}$$
;  $bx=E\{\overline{z}x, k \ dk\}$ 

Any sub-matrix Axy in (13) has now the form of the synchronous correlation matrix treated in [2]. From now on definitions (12) are assumed and, following [2] a DFD algorithm is proposed to make the sub-matrices Axy simultaneously diagonal.

Consider a 2N-taps fractionally spaced equalizer with  $N \ge M$ , and let

$$b' = [b_F | s_F | b_S | s_S]^T = [b'_F | b'_S]^T$$

be arbitrary expansions of A and b in (13). The quadratic form

$$\mathcal{E}(\mathbf{c}') = \mathbf{c}' \, \mathbf{A}' \, \mathbf{c}' - \mathbf{c}' \, \mathbf{b}' - \mathbf{b}' \, \mathbf{c}' + \mathbf{K} \tag{15}$$

equals the MSE expressed by (4) when  $\mathbf{c}'$  has the form

$$\mathbf{c}' = \left[\mathbf{c}_{\mathbf{F}}^{\mathsf{T}} \mid 0 \mid \mathbf{c}_{\mathbf{S}} \mid 0\right]^{\mathsf{T}} \tag{16}$$

that is when c' belongs to the subspace

$$G^{\dagger} c' = 0 \tag{17}$$

where  $G^{T}$  is the [2(N-M)x2N] matrix

$$G^{T} = \begin{bmatrix} 0 & | & I & | & 0 \\ ---- & | & ---- & | & ---- & | \\ 0 & | & 0 & | & I \end{bmatrix}$$
 (18)

Passing to the DFD can now be performed by means of N-point DFT's separately applied to the fractional and synchronous vectors. To this purpose definition of a new (2N)x(2N) transformation matrix is useful

$$W = \begin{bmatrix} W_T & 0 \\ --- & --- \\ 0 & W_T \end{bmatrix}$$
 (19)

where Wr is the N-point DFT matrix whose (m,n) element is equal to  $\exp[-j(2\pi/N)nm]$ . Matrix W when applied to z' and c' yields

$$W_{Z} = \begin{vmatrix} W_{T} & z'_{F} \\ ---- & -- \\ W_{T} & z'_{S} \end{vmatrix} = N \begin{vmatrix} Z_{F} \\ --- \\ Z_{S} \end{vmatrix}; \quad W_{C'=N} \begin{vmatrix} C_{F} \\ --- \\ C_{S} \end{vmatrix}$$
 (20)

It can be shown that non-stochastic minimization of (15) with constraint (17) can be accomplished for any non-singular (2N)x(2N) matrix  $\Phi$  by

$$\mathbf{c}'_{\mathbf{k}+1} = \mathbf{c}'_{\mathbf{k}} - \alpha \overline{W} P(\Phi \overline{\Phi}^{\mathsf{T}}) W(\overline{A}' \quad \mathbf{c}'_{\mathbf{k}} - \mathbf{b}) = \\ = \mathbf{c}'_{\mathbf{k}} - \alpha \overline{W} P(\Phi \overline{\Phi}^{\mathsf{T}}) (A_{\mathbf{k}} \quad \mathbf{C}_{\mathbf{k}} - B_{\mathbf{k}})$$

$$P = I - (\overline{\Phi} \overline{\Phi}^T) WG [G^T \overline{W} (\overline{\Phi} \overline{\Phi}^T) WG] - IG^T \overline{W}$$

$$C_k = (1/N) W C_k^{\dagger}$$
(22)

$$\mathbf{B}_{\mathsf{W}} = \mathsf{W} \; \mathbf{b} \tag{24}$$

For any choice of  $\Phi$ , algorithm (21) yields the same final constrained solution  $c_{\text{opt}}$ 

$$\mathbf{C'opt} = \overline{A'}^{-1} \{ \mathbf{I} - \mathbf{G} [\mathbf{G}^{\mathsf{T}} \overline{A'}^{-1} \mathbf{G}] - \mathbf{I} \mathbf{G}^{\mathsf{T}} \overline{A'}^{-1} \} \mathbf{b'}$$
 (26)

A stochastic gradient algorithm corresponding to (21) and converging in the mean to  $\mathbf{c}_{opt}^{\prime}$  is

$$\mathbf{c}'_{\mathbf{k}+1} = \mathbf{c}'_{\mathbf{k}} - \alpha \ \overline{\mathbf{W}} \mathbf{P}(\mathbf{\Phi} \overline{\mathbf{\Phi}}^{\mathsf{T}}) \mathbf{W} \ \overline{\mathbf{z}}'_{\mathbf{k}} \ \mathbf{e}_{\mathbf{k}}$$
 (27)

From (20) and (27) it is apparent that to compute the updating term a N-point DFT is separately applied to  $z_{F,k}$  and  $z_{S,k}$ , the resulting vector is deflected by  $(\Phi^{\overline{\Phi}^T})$ , projected by P and finally transfomed back to the time domain. To turn (21) into a self-orthogonalizing algorithm  $(\Phi^{\overline{\Phi}^T})$  is to be chosen to satisfy

$$\overline{\Phi}\overline{\Phi}^{T} = A_{W}^{-1} \tag{28}$$

Using (28) and (22) in (21) with  $\alpha=1$  it results  $c'_{k+1}=c'_{opt}$  for any  $c'_k$  i.e. onestep convergence occurs.

Arbitrary matrices Sxy1, Sxy2, Sxy3, with  $X,Y\in\{F,S\}$  in (14) can be chosen to simplify the computation of  $(\Phi^{T})$  in (28). This can be done by making all matrices A'xy circulant so that any  $Awxy = Wt \overline{A'}xy \overline{W}_T$  results diagonal [2].

To this goal let us define the (i,j)-th element of any A'xy as follows

$$A'xy(i,j) = (29)$$

$$\begin{cases} \operatorname{Rxy}(i-j) & \text{for} \\ [(|i-j| \leq M-1) (|i-j| < N/2)] (|i-j| < G) \\ \operatorname{Rxy}[i-j-\operatorname{sgn}(i-j) \cdot N] & \text{for} \\ (|i-j| \geq M) (|i-j| \geq N/2) \\ \operatorname{Rxy}(N/2) & \text{for} \\ (|i-j| = N/2) (N/2 \geq M) \\ 0 & \text{elsewhere} \end{cases}$$

For M≥G Axy is circulant for N≥M+G-1; for M<G Axy is circulant for N≥2M-1. In both cases any Awxy is diagonal with elements

$$Awxy(i,i) = N S\bar{x}\bar{y}(\omega_i)$$
 (31)

where  $SXY(\omega_i)$  is the cross spectrum (power spectrum for X=Y) of  $\{zx,k\}$  and  $\{zy,k\}$  computed at  $\omega_i=(2\pi/N)i$ .

30.4.3.

stochastic self-orthogonalizing algorithm requires the on-line estimation of  $(\bar{\Phi}\bar{\Phi}^T)=A^{\frac{1}{N}}$  to be used in (27) and to compute P in (22). Leaving projection to a later discussion, observe that an estimate of any Awxy at time kT can be obtained by means of the Bartlett method of averaging periodograms i.e. [2],[5]

ograms i.e. [2],[5]
$$\widehat{A}_{WXY}=(N^2/k+1)\sum_{i=0}^{k} \text{Diag } \overline{Z}_{X,i}\text{Diag } Z_{Y,i}$$
An estimate for  $(\overline{\Phi}^{\overline{\Phi}^T})$  in (28) is then

An estimate for  $(\overline{\Phi}\overline{\Phi}^{T})$  in (28) is then

$$(\widehat{\Phi}\widehat{\Phi}^{T})_{k} = \left\| \begin{array}{c} \widehat{A}_{WFF} \\ ---- \\ \widehat{A}_{WSF} \end{array} \right| \left| \begin{array}{c} \widehat{A}_{WFS} \\ ---- \\ \widehat{A}_{WSS} \end{array} \right|^{-1}$$
(33)

The matrix to be inverted in (33) is not diagonal as it resulted in the synchronous case but has only three non-zero diagonals which simplifies the inversion with respect to the time domain [see (10)]. A matrix of this kind has inverse of the same kind i.e.

$$\begin{bmatrix} a_0 & b_0 & -1 & \widetilde{a}_0 & \widetilde{b}_0 \\ a_1 & b_1 & -1 & \widetilde{a}_0 & \widetilde{b}_1 \\ \vdots & \ddots & \vdots & \widetilde{d}_0 \\ \hline c_1 & d_1 & \widetilde{c}_0 & \widetilde{d}_1 \\ \vdots & \ddots & \ddots & \vdots \end{bmatrix}$$
(34)

where the right-hand elements can be computed four at a time by inverting N 2x2 matrices according to the following

$$\begin{bmatrix} \widetilde{a}_{i} & \widetilde{b}_{i} \\ \widetilde{c}_{i} & \widetilde{d}_{i} \end{bmatrix} = \begin{bmatrix} a_{i} & b_{i} \\ c_{i} & d_{i} \end{bmatrix}^{-1}$$

$$(35)$$

For N>M an estimate for P\_should also be computed substituting  $(\widehat{\Phi}^{\overline{T}})_k$  in (22) while no projection is required in the non-expanded case N=M. In this case, conditions for circulancy of Awxy are not met and the estimate (32) is affected by aliasing error.

In spite of this, convergence is still speeded up by the use of the same estimate. Moreover computations of the DFT, via FFT, turn out to be particularly simple when very short equalizers can be used as, for example, in digital radio links affected by multipath. In fact 4-point FFT requires no multiplication.

Performance of algorithm (27) on the channel used in Fig.2 with  $(\Phi \overline{\Phi}^{\intercal})$  estimated by inverting (32) and used in (22) is shown in Fig. 3. In the same figure, performance of a non-expanded equalizer is presented.

5 - Stop-and-go algorithm for blind equalization when the tap setting of any equalizer is far from optimum, the decided symbols  $\widehat{\mathbf{d}}_k$  are largely incorrect and consequently the error ex=yx-dx used by the gradient algorithm in the decision-directed mode is unreliable. In fact the gradient

trained by an initial known sequence. In these conditions the Stop-and-Go algorithm proposed in [4] achieves convergence by stopping adaptation whenever the sign of the output error does not match that of the control

algorithm does not converge if not

$$\stackrel{\sim}{\mathbf{e}}_{\mathbf{k}} = \mathbf{y}_{\mathbf{k}} - \mathbf{\beta} \, \operatorname{sgn}(\mathbf{y}_{\mathbf{k}}) \tag{36}$$

where B is real and the sign of y (complex) is to be intended per component. Since only sign comparison is needed, the SAG algorithm results particularly simple.

When directly applied equalizers the algorithm is not as effective as in the synchronous case and blind convergence does not take place. This because multiple sampling increases the eigenvalue dispersion of the input correlation matrix. Blind convergence may be helped by reducing dispersion via self-orthogonalization.

#### 6 - The SAG-SO-DFD-FS equalizer

Combining the stop-and-go algorithm with DFD self-orthogonalization leads to the following algorithm

$$\mathbf{c}'_{k+1} = \mathbf{c}'_{k} - \alpha \overline{\mathbf{W}}(\widehat{\Phi}^{\mathsf{T}})_{k} \ \mathbf{W} \ \mathbf{z}_{k} \ \mathbf{e}_{B,k}$$
 (37)

where M=N assumed to is avoid projection,  $(\Phi \overline{\Phi}^{T})_{k}$  is computed by inverting (32) and

$$e_{B,k} = \begin{cases} \widehat{e}_{k} & \text{for sgn } \widehat{e}_{k} = \text{sgn } \widetilde{e}_{k} \\ 0 & \text{for sgn } \widehat{e}_{k} \neq \text{sgn } \widetilde{e}_{k} \end{cases}$$
(38)

Performances of algorithm (37) have been evaluated by computer simulation for a 6-tap FS equalizer (M=3) in a digital radio link environment with modulation format 256-QAM and a multipath dispersive channel on the signature at MSE=10-1.

In Figs. 4 and 5 the MSE versus the number of iterations is shown for two significant sample curves. It apparent the different convergence behavior between not using (Fig. 4) and using (Fig. 5) self-orthogonalization in conjunction with the SAG algorithm.

Actually in all tested situations the use of self-orthogonalization resulted mandatory to achieve fast blind convergence.

#### 7 - Conclusions

A self-orthogonalizing algorithm in the discrete frequency domain has been developed for application to complex fractionally spaced equalizers. Blind equalization based on a Stop-and-Go algorithm has been also considered for the same equalizers.

Ιt has been that shown fractionally spaced equalizers blind convergence is substantially helped by self-orthogonalization. To this purpose a combination οf the previously developed DFD self-orthogonalizing algorithm with the SAG algorithm resulted effective.

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<u>Signal</u> <u>Processing</u> Englewood Cliffs, NJ:
Prentice-Hall, 1975

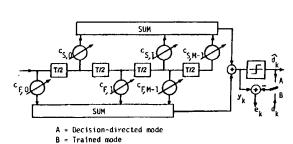


Fig.1 - Basic scheme of the fractionally spaced equalizer.

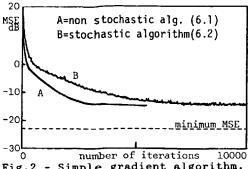


Fig. 2 - Simple gradient algorithm. M=4 (8 taps). Trained mode.

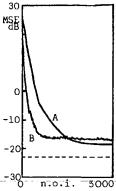


Fig. 3 - DFD autoorthogonalizing algorithm. Stochastic algorithm (27) with (32). Trained mode. A: Expanded case: M=4, N=12 (24 taps) and (22).

B:Non-expanded case: M=N=4 (8 taps) and no projection.

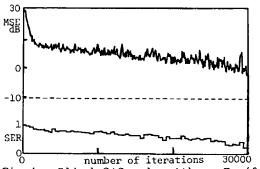


Fig. 4 - Blind SAG algorithm: Eq. (6.2) with  $e_{B,k}$  from (38) instead of  $e_k$ . M=N=6.

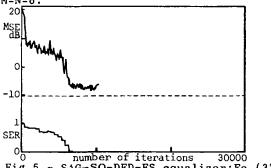


Fig. 5 - SAG-SO-DFD-FS equalizer: Eq. (37) with (32) and (38). M=N=6.

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1 SVD iterative decision feedback demodulation and detection of code space-time unitary differential modulation

Steiner, A.; Peleg, M.; Shamai, S.;

Information Theory, IEEE Transactions on , Volume: 49 , Issue: 10 , Oct. 20C Pages: 2648 - 2657

**IEEE JNL** 

[Abstract] [PDF Full-Text (473 KB)]

#### 2 A blind Sag-So-DFD-FS equalizer

Picchi, G.; Prati, G.;

Communications, 1988. ICC 88. Digital Technology - Spanning the Universe. Conference Record. IEEE International Conference on , 12-15 June 1988 Pages:957 - 961 vol.2

[Abstract] [PDF Full-Text (308 KB)] **IEEE CNF** 

#### 3 Minimum mean-squared error multiuser decision-feedback detector DS-CDMA

Woodward, G.; Ratasuk, R.; Honig, M.L.; Rapajic, P.B.; Communications, IEEE Transactions on , Volume: 50 , Issue: 12 , Dec. 2002 Pages: 2104 - 2112

[Abstract] [PDF Full-Text (576 KB)] IEEE JNL

#### 4 Self-Orthogonalizing Adaptive Equalization in the Discrete Frequence Domain

Picchi, G.; Prati, G.;

Communications, IEEE Transactions on [legacy, pre - 1988], Volume: 32, Is 4, Apr 1984

Pages: 371 - 379

[Abstract] [PDF Full-Text (1008 KB)] IEEE JNL

5 Speed and accuracy comparison of techniques to solve a binary quadratic programming problem with applications to synchronous CD

Hasegawa, F.; Luo, J.; Pattipati, K.; Willett, P.;

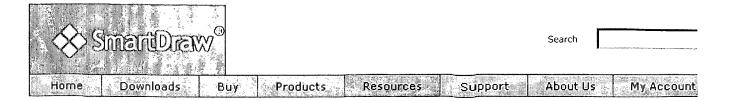
Decision and Control, 2001. Proceedings of the 40th IEEE Conference on , Vo 5 , 4-7 Dec. 2001

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Brad Henry - Software Engineer

# Software Design Center HOW TO DRAW SSADM DIAGRAMS (cont'd)

#### **Entity Event Matrix**

Draw an entity event matrix to identify the events that affect the system. You can do this easily in Small

#### **EVENTS**

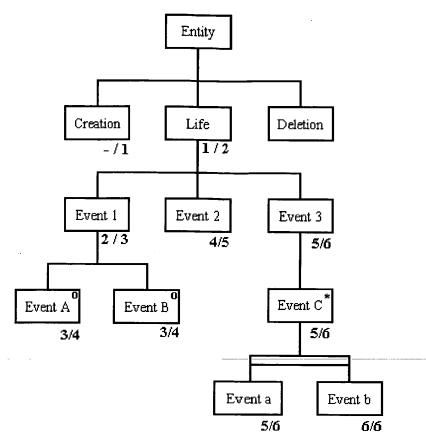
ENTITY	Event A	Event B	Event 0
Entity 1	×		X
Entity 2		X	**************************************
Entity 3	X		X
Entity 4		X	

An Entity Event Matrix

To draw an entity event matrix in SmartDraw, use tables. For a tutorial on how to manipulate tables, cli

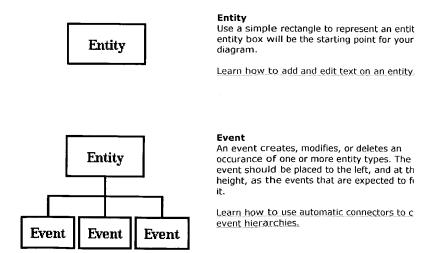
#### **Entity Life History Diagram**

An Entity Life History (ELH) diagram represents the life cycle of entities within the database.



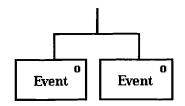
An Entity Life History diagram

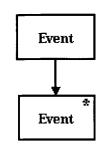
#### **Entity Life History (ELH) Notations**



#### Selection

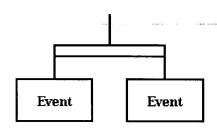
To represent a choice between a number of alternative events, mark the events with a  $\epsilon$  "o" (for option) on the upper right hand corn





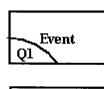
#### Iteration

If an event is repeated, place a small asteri: in its upper right hand corner. All events un single node must be of the same type. In ot words, don't mix and match iteration, select and sequence event notations.



#### Parallel Structures

To illustrate an event that has no major effethe system, such as a change of an address employee, use a parallel bar to note this exito the system's normal life.



#### **Quit and Resume**

To represent an unusual event (i.e. an empl taking family medical leave), you can use paragraph and resumer events. Each event mark a "Q", can be replaced by an event marked "R."



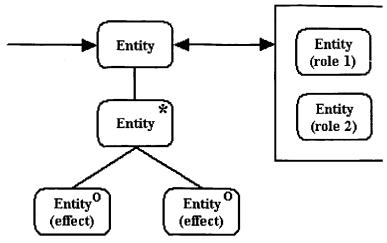
#### State Indicators

Place state indicators (SIs) under each ever indicate the states that precede and follow i a slash to divide the states before and after event takes place.

-/1 1/2

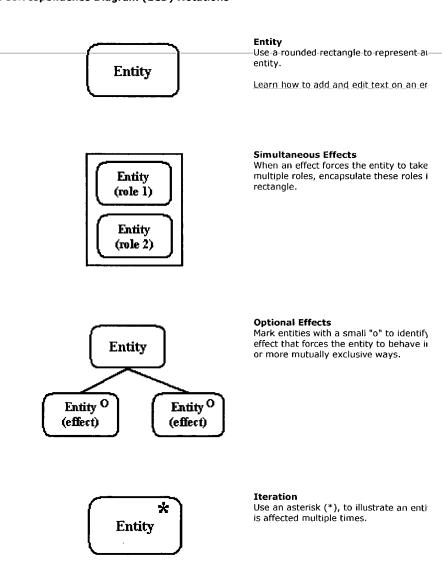
#### **Effect Correspondence Model**

Effect Correspondence Diagrams (ECD) illustrate all the entities affected by a given event.



An Effect Correspondence Diagram

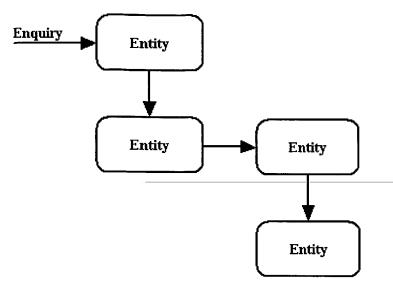
#### Effect Correspondence Diagram (ECD) Notations





#### **Enquiry Access Paths (EAPs)**

Enquiry Access Paths (EAP) define a route through the Logical Data Model to satisfy a particular enquiry crow's foot relationships and relationship labels and replace them with EAP arrows.



An Enquire Access Path Diagram

To draw an EAP in SmartDraw, use a simplified LDM with arrows indicating the direction of the enquiry.

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- SSADM, A Practical Approach, 1990, (Version 4 book due 1995) by Ashworth/Slater & Goodland, pub McGraw-Hill
- Practical SSADM V4, Philip L. Weaver, Pitman Publishing, 1993
- SSADM Version 4: A User's Guide, (2nd Ed), Malcom Eva, McGraw-Hill, 1994

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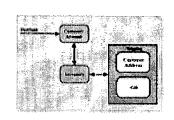
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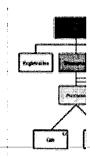
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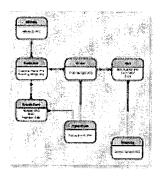
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# **Business Process Modelling Tools (By Technique)**

# Techniques:

- IDEF
- Petri-net (CPN)
- Yourdon (DFD)
- UML
- Booch
- Rumbaugh
- Shlaer-Mellor
- Coad/Yourdon
- Martin
- Chen
- SSADM
- Bachman
- Gantt
- Object Oriented
- Soft Systems
- Meta Modelling
- Flow Chart
- ABC
- Workflow
- Simulation

# Tools that support IDEF

- 4Keeps
- AIO WIN
- BPWin
- Business Object Modelling Workbench
- CORE
- Design IDEF
- Design Leverage
- IDEF Tools
- Popkins Systems Architect
- Pro CAP Pro SIM
- Process Maker
- SA/BPR Professional
- Workflow Modeler

# **Tools that support Petri-net (CPN)**

- Design CPN
- INCOME
- PACE
- Process Maker
- Process Weaver

# **Tools that support Yourdon (DFD)**

- 4Keeps
- BONAPART
- GRADE
- Paradigm Plus
- Popkins Systems Architect
- Softwarethrough Pictures SE
- With Class 98

# Tools that support UML

- 4Keeps
- Class Designer
- COOLJex
- Innovator
- j-vision
- Javision
- LOREx2 for Java
- Magic Draw UML
- Object Plant
- Objecteering
- Paradigm Plus
- Pragmatica
- Real-time Studio
- Rhapsody
- SDT
- Soft Modeler Business
- Softwarethrough Pictures UML
- Together C
- Together J
- Visual UML
- With Class 98

# Tools that support Booch

- 4Keeps
- Class Designer
- Paradigm Plus
- Softwarethrough Pictures Booch
- With Class 98

# **Tools that support Rumbaugh**

- 4Keeps
- Paradigm Plus
- Select Enterprise

# Tools that support Shlaer-Mellor

- 4Keeps
- Bridge Point Automation Tools
- Paradigm Plus
- SES/objectbench
- With Class 98

# Tools that support Coad/Yourdon

- 4Keeps
- Paradigm Plus
- Together C
- With Class 98

# **Tools that support Martin**

- 4Keeps
- Kappa
- Object Management Workbench OMWtm
- Paradigm Plus

# Tools that support Chen

- 4Keeps
- Softwarethrough Pictures IM

# Tools that support SSADM

- 4Keeps
- SSADM

# **Tools that support Bachman**

• Bachman Analyst

### **Tools that support Gantt**

- ABT Project Workbench
- PFTamptrade
- Project Scheduler7
- Team Flow
- Workflow.BPR

# **Tools that support Object Oriented**

- BRWin A&D
- Class Designer
- ICONIXOOAamp D Power Tools
- Kappa
- Live Analyst
- Mac Aamp D
- Meta Edit
- Object GEODE
- Object Management Workbench OMWtm
- Object Modeler
- Object Team
- OODesigner
- Paradigm Plus
- Process Flo
- Quick CRC
- radica
- Rhapsody
- SA/Object Architect
- Select Enterprise
- System Architect
- The Electronic Workforce

# **Tools that support Soft Systems**

# **Tools that support Meta Modelling**

- AWD and Workflow Analyzer
- Meta Edit
- Meta Edit Method Workbench
- Meta Edit Personal
- Metaphase 2.0
- Metaview FOLDERS
- Power Designer
- Process Maker
- Softwarethrough Pictures Booch
- Softwarethrough Pictures OMT
- Work Flow Analyzer

### **Tools that support Flow Chart**

- ABC Flow Charter 4.0
- ABC Graphics Suite
- ABT Project Workbench
- AWD and Workflow Analyzer
- Bench Marker Plus
- BPM
- Business Object Modelling Workbench
- Cap Web-Flow
- CLEAR

- COI-Business Flow
- CORE
- COSA
- CSEWorkflow 5.0
- Docu Flow
- EPM Suite
- Flow Maker
- Flow Path
- Flow PATH IMAGEWorks
- Flowcharter
- Flowmark
- Form Flow
- Free Flow
- GOOFEE Diagrammer
- IBMBusiness Process Modeler
- Jet Form Server
- MAXIM
- Net Prophet
- OCTOFlow
- Optix Workflow
- PAVONE Group Flow
- PFTamptrade
- Power Flow
- Power Flow Team Flow Process Wise
- Pro Model
- Process Charter
- Process Maker
- RKB Work Frame
- SA/BPR Professional
- Smart Flow 98
- Vectus
- Visual Thought
- Work Flow Analyzer
- Work FLOW SQL
- Work Flow.2000
- Work Flow.2020
- Work Xpert
- Workflow FONT FACESymbolmiddot FONTBPR
- Workflow Modeler
- Workflow.BPR

## Tools that support ABC

- AIO WIN
- Bench Marker Plus
- Easy ABCQuick
- Extend BPR
- TI BDF
- TOP-IX

## Tools that support Workflow

- 1View Workflow
- ABSI-Docs
- Action Request System
- Action Workflow Analyst
- Action Workflow Application Builder
- Action Workflow Enterprise Series
- Action Workflow Workflow Manager
- ARIS
- ATIWorkflow Manager
- Automated Work Distributor AWD
- AWD and Workflow Analyzer
- Beyond Mail
- BONAPART
- Business Object Modelling Workbench
- Cap Web-Flow
- CMSWorkflow
- COI-Business Flow
- Computron Workflow
- COOL
- COSA
- CSEWorkflow 5.0
- Designer2000
- Docu Flow
- Document Manager
- Documentrix Workmanager
- EDI36
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- Flow Man
- Flow PATH IMAGEWorks
- FLOWBuilder
- Flowmark
- Form Flow
- FORO
- FYI
- FYI Workflow
- Group Wise

- IBIsys
- IBMBusiness Process Modeler
- IBS Workflow Manager
- Image Fast
- Image Master
- In Concert
- Inter Office
- Jet Form Server
- Key Workgroup
- Keyflow
- Life FLOW
- Link Works Team Links
- Linkworks
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- MAVIM 3
- Memo
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- Workflow.BPR
- WORKlogik TM
- World Wide Web Flow W4
- XWorkflow

## **Tools that support Simulation**

- AWD and Workflow Analyzer
- BONAPART
- BPSimulator Template
- Business Object Modelling Workbench
- Business Process Analyzer
- Bwise Toolkit
- CABRE -Witness
- Cinderella SDL
- CLEAR
- Clear Process
- Design CPN
- Design Leverage
- Dress Rehearsal
- EPM Suite
- First STEP
- Flowcharter
- GRADE
- HITSoft BIZ
- HOCUS
- i-think
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- Live Analyst
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- Oracle Process Manager
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- Prophesy

- PROSIM Process Modeling Software
- Quick CRC
- RDD-100
- SES/Workbench
- SIMAN amp ARENA
- SIMPROCESS
- Soft Modeler Business
- SPARKS G2
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## **SSADM** - an Introduction

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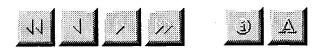
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# **SSADM** - an Introduction

- Structured Methods
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  - History
- SSADM
  - History of SSADM
  - Components, Inputs and Outputs
  - Techniques
  - Documentation and CASE tools
- SSADM in the Systems Life Cycle
  - Brief discussion of each stage
  - Costs and Problems
- · Sources of Information

Intro to SSADM 1

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## **Structured Methods**

- Characteristics of Structured Methods
  - used for requirements specification, systems design
  - structure a project into small, well-defined activities
  - specify the sequence and interaction of these activities
  - use diagrammatic and other modelling techniques:
  - give a precise (structured) definition
  - are understandable by both users (clients) and developers

Intro to SSADM 2

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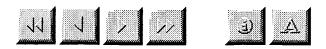


## Some claims for Structured Methods

- reduce life cycle development costs through improved analysis and design
- improve quality of systems delivered
- improve project management, planning and control
- more effective use of inexperienced staff
- improve communication
  - user analyst
  - analyst designer
  - designer programmer
  - analyst analyst, designer designer
- · self documenting

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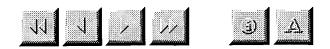


## **History and examples**

- Yourdon (Structured Design) late 1970s
- DeMarco (Structured Analysis) late 1970s
- · Merise (France) late 1970s
- Information Engineering (Finkelstein and Martin)- late 1970s / early 1980s
- Structured Systems Analysis and Design
   Method (SSADM also LSDM) 1980

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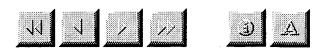


## History of SSADM

- 1980 Central Computer and Telecommunications Agency (CCTA) evaluate analysis and design methods
- 1981 LBMS method chosen from shortlist of five
- 1983 SSADM made mandatory for all new information system developments
- 1984 Version 2 of SSA DM released
- 1986 Version 3 of SSADM released, adopted by NCC
- 1988 SSADM Certificate of Proficiency launched, SSADM promoted as 'open' standard
- 1989-Moves-towards-Euromethod, launch-of-CASEproducts certification scheme
- 1990 Version 4 launched
- 1993 SSADM V4 Standard and Tools Conformance Scheme Launched
- 1995 SSADM V4+ anounced, V4.2 launched

Intro to SSADM 5

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# **Components of SSADM**

- Structures
  - define the frameworks of activities, steps and stages and their inputs and outputs
- Techniques
  - define how the activities are performed
- Documentation
  - define how the products of the activities, steps and stages are presented

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## INPUTS to and OUTPUTS from SSADM

## Inputs

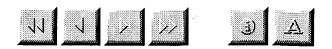
- Project Initiation Document
  - » Business Case
  - » Terms of reference
  - » Project boundaries
  - » Project management
- Reports from Previous Studies
  - » Feasibility Report
  - -»-IS-Strategy-Report

## Outputs

- Program Specifications
- File / DB Specifications
- User Procedure Specifications
- Operations Procedure Specifications

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## Size and application areas

- Project size:
  - Small 1-2 persons, < 1 man year
  - Medium 4 10 persons, 1 to 20 man years
  - Large
- Implementation media:
  - Micros, Minis, Mainframes, Distributed and Replicated systems
  - COBOL and other 3GLs, 4GLs, application packages, turnkey developments
- Start point has been:
  - No existing system
  - Manual system or partially automated system
  - Maintenance of existing systems

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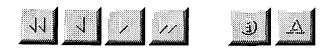


# **SSADM Techniques and Models**

- Logical Data Models
- Data Flow Models
- Requirements Definition
- Function Definition
- Specification Prototyping
- Relational Data Analysis
- Entity/Event Modelling (Entity Life Histories and Effect Correspondence Diagrams)
- Business and Technical Options
- Dialogue Design
- Update and Enquiry Process Models
- Physical Data Design
- Physical Process Specification
- Physical Design Control

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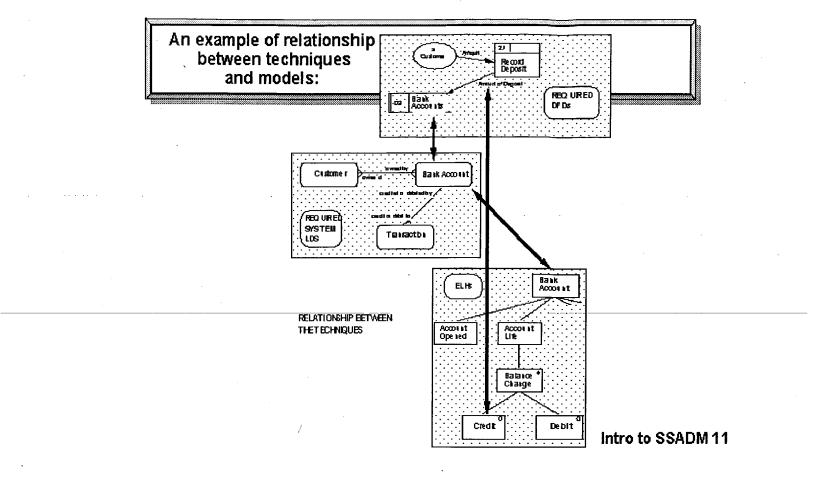
# **Complementary techniques**

- Quality Assurance Reviews
- Formal Documentation
- Project Control Methods
- Use of CASE Tools

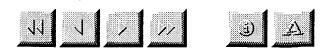
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## **Documentation and CASE tools**

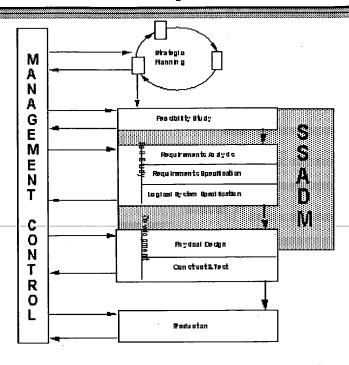
- Different kinds of documents produced:
  - diagrams
  - forms
  - matrices
  - narrative reports
- Many projects now using Computer Aided Systems Engineering ( CASE tools ) for:
  - --producing-high-quality-documentation
  - enabling rapid amendment of diagrams and other structured information
  - checking consistency and completeness

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# **SSADM** in the Systems Life Cycle



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# Strategic Information Systems Planning

- · Becoming very popular:
  - high investment in IT needs control
  - Info Sys very important to competitive position
  - Many methods and consultancies on offer
  - End products of Strategic Information Systems (IS)
     Planning usually:
    - » analysis of present position ( problem s, costs, opportunities)
    - »-recommendations-for-future-ISs-and-enhancements
    - » total plan for all IS development
    - » outline plans and scoping for each IS project

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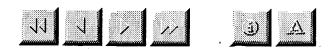


# Feasibility Study

- Is the project
  - technically possible?
  - financially and socially justified?
  - acceptable to the organization?
- · Requires some analysis and design

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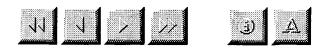


# Requirements Analysis and Specification (1)

- Analysis of current system
  - operations
  - problems
  - volumes and costs
- Specification of requirements for a new system
  - the what rather than the how
  - functions
  - data
  - inputs and outputs

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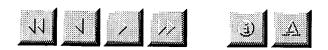


# Requirements Analysis and Specification (2)

- · Information collected by
  - interviews
  - questionnaires
  - from previous studies
  - record searching
  - observation
- System (both current and future) described by
  - narrative.
  - system models (structured information)

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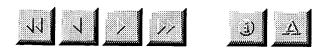


# Logical System Specification (Business Systems Design)

- broad specification from systems analysis
- technical solutions to the requirements are evaluated
- detailed logical (non-technical) design developed which shows clearly how the new system will operate within the business
- narrative and system models used

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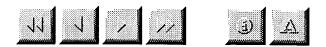


# **Physical Design**

- Logical design converted to a physical (technical) one
  - File specifications or database definitions
  - Program specifications
  - Screen and report specifications

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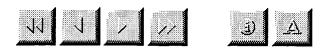


# **Construction & Testing**

- Programming
- Assembly
- Testing
- Many projects now using 4GLs and building prototypes earlier in the SLC

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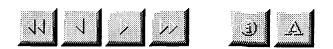


# **Transition**

- from operating the old system to operating the new
- Involves:
  - installation of equipment
  - conversion of old system data to the formats required by the new
  - training of and handover to users

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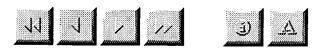


## **Production**, Maintenance and Review

- when the system is operating and producing the required information
- Maintenance required throughout the production phase:
  - correction of errors
  - adaptation to new software and hardware releases
  - enhancements
- Review to show
  - How well it has met the requirements and objectives set for it?
  - Does it continue to meet the users requirements?
- These enhancements and reviews may lead into further system studies

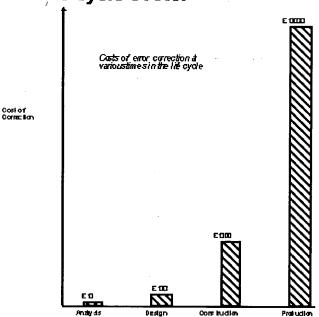
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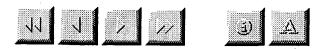
## Costs associated with the SLC

Maintenance absorbs ca. 70% of total systems life cycle costs.



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## **Sources of Information**

### SSA DM

- SSADM Reference Manual, 1986(Version 3), 1990 (Version 4), NCC
- SSADM, Application and Context, 1991 (2nd Edn), by Downs, Clare, & Coe, pub Prentice-Hall
- SSADM, A Practical Approach, 1990, (Version 4 book due 1995) by Ashworth/Slater & Goodland, pub McGraw-Hill
- Practical SSADM V4, Philip L. Weaver, Pitman Publishing, 1993
- SSADM Version 4: A User's Guide, (2nd Ed), Malcom Eva, McGraw-Hill, 1994

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